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Energy Alberta 1989

CANADIANA

JUN 26 1990

> **"...he belonged to the land..."**
> Pearl S. Buck, *The Good Earth*, 1931

Energy Resources Conservation Board
Review of Alberta Energy Resources in 1989

ERCB

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Energy Alberta

Each year **Energy Alberta** reviews energy developments within the province, seeking to place them within the context of both Canadian and global trends. In addition to presenting statistical data not readily available elsewhere, this publication tries to provide some insights into what those data mean, in both human and economic terms.

Energy Alberta is published by the Energy Resources Conservation Board. The ERCB is an independent body which–in the words of its mission statement–"ensures the orderly, efficient, economic, safe and environmentally sound development of the energy resources of Alberta.

"In carrying out this mission, the ERCB must administer its statutes in a manner that is just and fair, and responsive to the needs and concerns of the Government and people of Alberta, and of the energy industry."

To demonstrate how the ERCB interprets this mandate in practical ways, this edition features a special section entitled "The Good Earth." In regulating resource developments, much of the ERCB's work involves the environment. We will investigate how the development of one resource can impact on another, both positively and negatively, and how those impacts are managed.

The editors and contributors to **Energy Alberta 1989** trust that they have in some measure succeeded in explaining this complex mission. As always, we welcome and encourage reader input.

Oil

Gas

Oil Sands

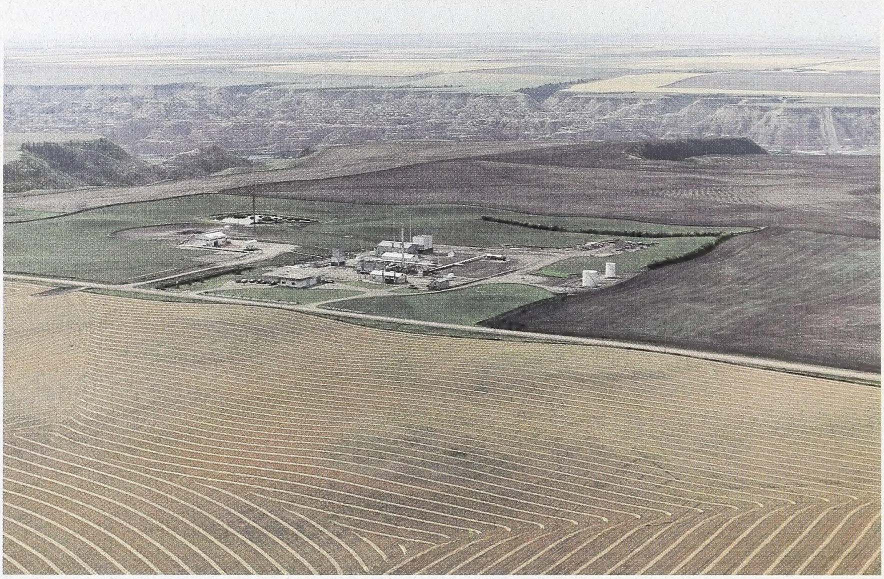
Coal

Electricity

The colour bars above relate to specific energy resources. These same colours are used in charts throughout the publication.

Table of Contents

3 **Important Events of 1989**
7 **The Good Earth and the ERCB**
11 **Environmental Issues**
14 **Alberta's Energy Resources**
31 **Sales and Distribution**
35 **Revenues, Investment, Employment**
37 **Alberta Energy in Perspective**
40 **ERCB Operations**



A gather of gas, a harvest of wheat and a badland ecosystem–Alberta's "good earth" provides sustenance to a society increasingly interested in sustainable development of all its resources.

Metric/Imperial Energy Equivalents

Energy	1 petajoule	=	energy equivalent of 164 000 barrels of crude oil
		=	energy equivalent of 1 billion cubic feet of natural gas
Oil	1 cubic metre	=	6.3 barrels
Natural Gas	1 cubic metre	=	35.3 cubic feet
Coal	1 tonne	=	0.98 long ton (2240 pounds)
		=	1.1 short ton
Distance	1 kilometre	=	0.621 miles

Important Events of 1989

For much of Alberta's energy industry, 1989 was not a year of major gains. Several factors combined to dampen the general level of activity.

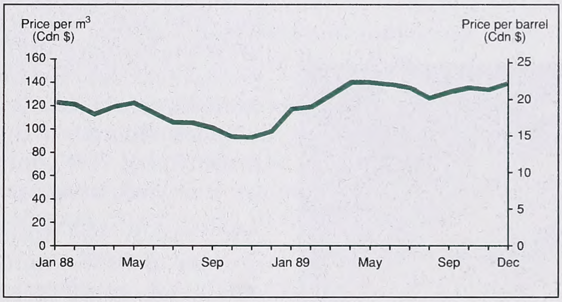
Perhaps the most significant negative factors were weak oil prices in 1988 and the related uncertainty as to future pricing. Initial drilling plans for 1989 tended to be fairly pessimistic. Although oil prices recovered considerably during the year, this had limited impact on industry activity. Indeed, the attention of several major companies was diverted largely from drilling to merger activity.

The end of several government incentive programs also contributed to less aggressive drilling in 1989. In the general economic arena, high interest rates and a gradually appreciating exchange rate tended to increase the cost of capital and reduce the value of energy exports.

On the positive side, total investment funds for oil and gas activity rebounded sharply in 1989 after a precipitous decline in 1988, with external financing quadrupling, 1989 versus 1988.

1. Alberta Weighted Average Field Price Light and Medium Oil

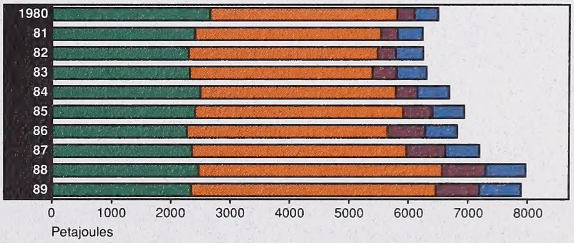
Increases in the 1989 average price of oil were offset by the stronger performance of the Canadian vs American dollar. However, the 1989 price of oil recovered from the low levels of late 1988.



2. Alberta Hydrocarbon Energy Resources
10-year production

Despite yearly fluctuations, the decade of the 80s traced the growing importance of natural gas in Alberta's total energy picture.

🟩 Oil
🟧 Gas
🟪 Oil Sands
🟦 Coal



Independents Take Up Slack

While several of Alberta's larger companies focused on mergers and acquisitions, smaller companies took up the slack and did the greater part of Alberta's oil drilling and exploration during 1989.

It has been more than 40 years since the Leduc oil discovery, and Alberta now is described by many geologists as a "middle-aged basin." Recent oil discoveries have tended to be small and varied, although of sufficient potential to promote interest by many in the energy industry.

Exploration Shifts to Natural Gas

Alberta's natural gas industry experienced an optimistic year in 1989 despite falling natural gas prices. Sustained demand for natural gas —especially in the United States—reinforced by environmental concerns to utilize cleaner burning fuels for electrical generation, created a demand for increased pipeline capacity and the proving of additional reserves. Thus, while total drilling activity in Alberta declined, gas exploration held its own during 1989. This shift to gas drilling is expected to be a major trend for Alberta in the foreseeable future.

Tough Year for Sulphur and Petrochemicals

Alberta's production of sulphur—a by-product of natural gas processing—was hard hit in 1989 by the collapse of a contractual agreement between Morocco and India. Morocco produces large quantities of phosphoric acid for India's fertilizer industry, using sulphur imported from Alberta. When India cancelled its purchases, Alberta's overseas sulphur shipments dropped by one-third. As a result, during the first 6 months of 1989, sulphur production in Alberta exceeded shipments. By year-end, however, total shipments once again exceeded production.

Additionally, the world petrochemical boom appeared to peak in the final quarter of 1988. Ammonia, the last major chemical to join the boom, was the most severely affected when the agricultural sector used less ammonia than had been anticipated. Because these markets are expected to recover, major developments are being considered in Alberta by Dow Chemical Canada, Neste Oy, Du Pont Canada and Union Carbide Canada.

Crude Oil Prorationing

Crude oil prorationing was a feature of Alberta's oil patch for many years. Since the deregulation of prices in 1985, the ERCB has been reviewing the need for the prorationing system in light of changing market conditions and pipeline capacities. This work has been done in co-operation with industry.

A Modified Proration Plan was introduced in 1987, freeing crude oil producers and shippers to make their own sales arrangements. Under the revised system, virtually all available crude oil in Alberta has been marketed successfully since 1987.

Although it is now believed that there will be no need for crude oil prorationing in the future, an industry/ERCB task force concluded that some form of prorationing system should be maintained as a contingency and that the Board should replace its reserves-based method of prorationing with a simpler system of pipeline prorationing. The Board took the first steps to implement the revised system in July 1989.

Pipeline prorationing has the advantages of being easier to understand, easier to implement on short notice, and responsive to local problems without involving producers province-wide. The information system that will permit pipeline prorationing to be implemented is presently being developed. In the meantime, the ERCB will continue to maintain its reserves-based prorationing system.

The ERCB will maintain a system of maximum rate limitations (MRL), and other conservation-related restrictions that are imposed through an MRL Order, to prevent waste and provide for the orderly development of crude oil resources.

Pipeline Expansion Vigorous

The long-term demand for and supply of Alberta's natural gas gives promise of gas being the focus of energy development activity in the future. To achieve that goal, however, a vigorous pipeline expansion program will be necessary. NOVA Corporation of Alberta—which operates the province's gas transmission system—invested $400 million in 1989, part of a major expansion program to extend into the 1990s.

Additionally, 1989 saw proposals to expand no less than five major pipeline systems carrying Alberta's oil and gas to the west coast, eastern Canada, the northeastern U.S. and California. While none of these proposals actually have received approval to begin construction, it is clear that such future expansion could result in increased export opportunities for the industry.

Caroline Field Draws Two Applications

During 1989, the ERCB received two applications—the first from Shell Canada Limited, the second from Husky Oil Ltd.—to construct the processing facilities required to handle the natural gas to be produced from the Caroline Field. This field, discovered in 1986, is Alberta's largest single gas discovery of the '80s. It is estimated that the Caroline Field alone added 10 per cent to Alberta's total reserves of natural gas.

Gas Processing Plant Applications

In recent years, some gas producers have brought to the ERCB's attention what they view as "unreasonably high" custom processing fees being charged them by gas plant operators. At the same time, members of the public have protested that there are more gas plants in their areas than seem necessary.

In response to these concerns, the Board and the government urged industry to review existing practices. A broad industry task force was struck to review custom processing fees. The Board also issued a draft informational letter for consideration by the industry, describing possible guidelines for dealing with new processing facilities. At year-end both studies were nearing completion.

Public Involvement Guidelines

Two important milestones occurred during 1989 in the area of public involvement in the development of energy facilities in Alberta. In June, the ERCB and Alberta Environment jointly published new guidelines designed to encourage innovative communications approaches by the industry, to ensure that Albertans would be aware of proposed developments at an early stage and to provide opportunities to participate in the planning, evaluation and lifelong operation of such projects.

In October, the Canadian Petroleum Association published *Public Consultation Guidelines for the Canadian Petroleum Industry*, a handbook designed to provide practical assistance to companies wishing to effectively carry out public and community consultation efforts.

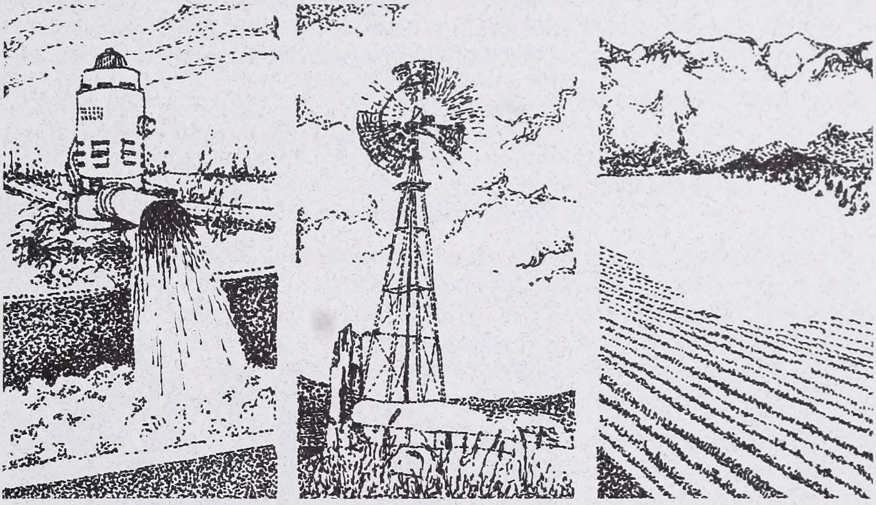
Historic Leduc Pool Begins Blowdown

An interesting footnote in the history of Alberta's oil industry occurred on 1 November 1989 when Esso Canada Resources officially launched the Leduc Blowdown Project. After more than 40 years of oil production from the Leduc D3-A oil pool, the gas cap that had helped sustain the flow of that oil began to be produced in 1989 (also known as "blowing down" a pool).

The Good Earth and the ERCB

Today, very few of us relate to the land as did Wang Lung, the principal character in Pearl S. Buck's classic 1931 novel, ***The Good Earth****. "He belonged to the land," she wrote, "and he could not live with any fullness until he felt the land under his feet . . ."*

This section of ***Energy Alberta*** *describes some of the ways in which the ERCB tries to protect the good earth of Alberta while at the same time regulating the safe and efficient development of energy resources.*



The closing decade of the twentieth century holds potential for major conflict between the drive for resource development and the need to protect the environment. As global consciousness about environmental damage has risen sharply, individuals and organizations throughout the world have been working to find practical means of initiating what the 1987 Brundtland Commission targeted as "sustainable development."

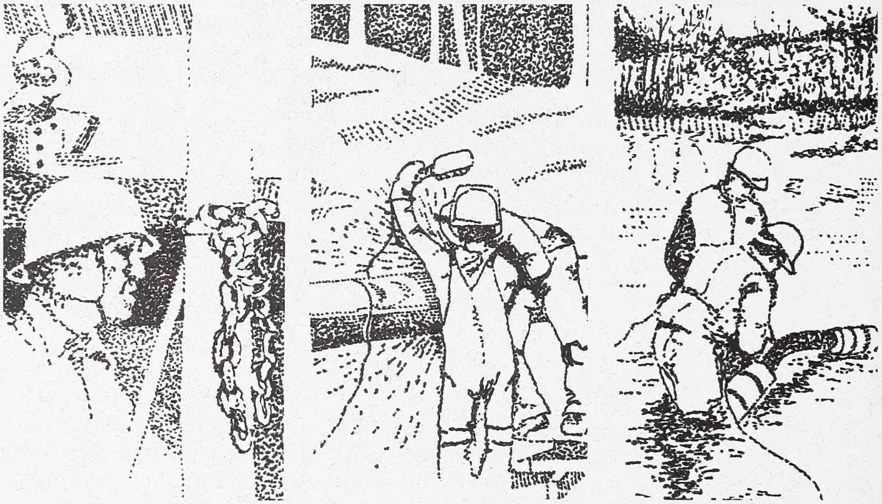
While solving global environmental issues may be beyond the scope of a government regulatory agency such as the ERCB, the Board is charged with making decisions regarding energy developments—decisions that must be made in the best interests of all Albertans, and in a broader context, for Canadians.

This year's issue of **Energy Alberta** places some of today's concerns regarding environmental protection and energy developments in perspective. It discusses some of the ways the ERCB has tried to mitigate the negative effects of energy developments, particularly on Alberta's soils, water courses and ecological systems. This opening section focuses primarily on broad philosophical issues, leading to an elaboration of steps the ERCB has taken to carry out its role in environmental matters.

Energy Fuels Growth, but Not Without Consequences

Just a couple of decades ago, the world accepted the positive benefits of energy developments with only minor questioning. The possible negative environmental effects of these developments received little public attention. However, priorities have changed dramatically, particularly in the last years of the '80s. The regulatory process has endeavoured to adjust to those changes.

Hydrocarbon resources—whether they be oil, gas or coal—are key ingredients in economic prosperity, providing fuel to heat our homes, run our vehicles and produce electric power. As well, they are the building blocks for a wide variety of the petrochemical and pharmaceutical products that improve and enrich our daily lives. Sold outside the province, they generate cash to help pay for the various goods and services we enjoy.



The development of hydrocarbons inevitably causes some land disturbance. Oil and gas drilling, pipeline construction, coal mining, and the building of hydro dams and oil sands developments have positive economic and social benefits; but all can have deleterious effects on the environment, too.

So the question remains, “How can we enjoy the benefits without doing irreparable damage to the world around us?”

Creating Sustainable Development

The challenge to protect the land, air and water seems immense. But what exactly should be done? How does the ERCB promote the sustainable process?

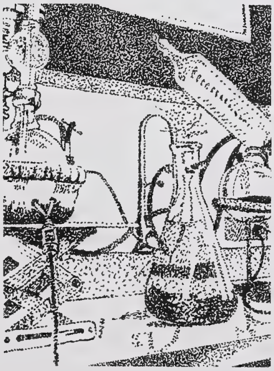
The ERCB and the energy industries it regulates have a major responsibility to protect and maintain Alberta's ecology. Both acknowledge past mistakes and the good things that have been done in planning appropriate action for the future. In Alberta, the ERCB looks at the interaction of various energy projects with existing human endeavours and with the natural environment, finding ways to balance many opposing forces.

While ongoing research is needed, the province cannot simply hold back on all development until that research has been concluded, nor can we delay rectifying problems. Fortunately, the information now in place as adequate to permit development at acceptable risk levels without causing irreversible damage to the environment.

An obvious first step is to eliminate as much pressure as possible on the land base. Particularly in developed nations such as our own, there are efforts to "reclaim, recycle, reduce and reuse" the products, by-products and wastes society produces. The objective should be to continue to maintain satisfactory living standards, while eliminating as much as possible any harmful effects on the world in which we live.

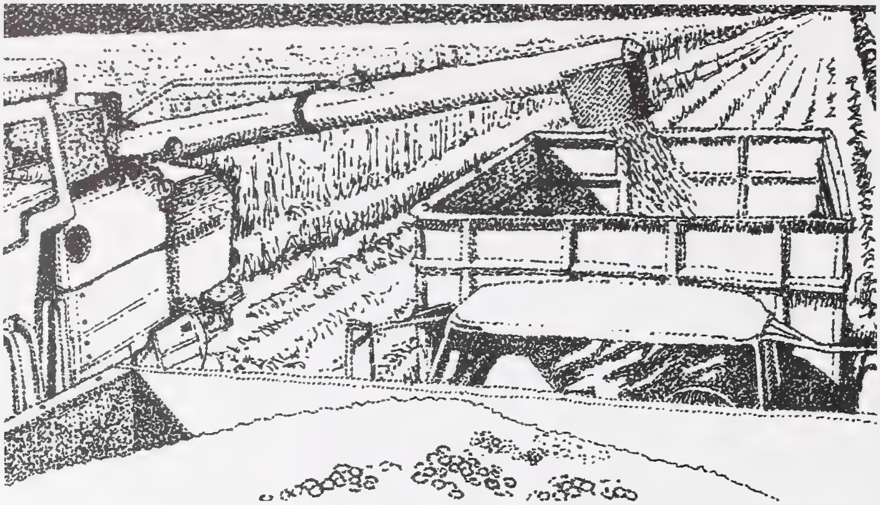
In Alberta, the ERCB has a legislated mandate to ensure that energy developments do not unnecessarily disrupt the long-term use of agricultural lands. For example, a pipeline right of way that disturbs agricultural land will usually be fully productive within 2 years of construction. The ERCB also encourages the placement of energy developments on sites that will minimize disruption and helps ensure that lands used for energy developments are properly reclaimed.

Another major concern is to ensure industrial emissions do not unduly impact on the land and water. Ensuring that emissions from gas plants, power plants and oil sands projects do not exceed standards is a shared responsibility of the ERCB and Alberta Environment.



In Central and Eastern Canada emissions of sulphur from industrial plants in Ontario and the United States have precipitated onto forests, farms and ultimately into susceptible lakes. The most apparent effect has been the die-off of fish and withering of trees—a significant compromise of an ecosystem.

In Alberta, there have not been any significant adverse effects of acidifying pollutants on vegetation, soil and surface waters. While there have been small incidents of localized damage from events such as the Lodgepole sour gas well blowout in the early 1980s, widespread damage seems to have been avoided. Long-term research studies—such as the Acid Deposition Research Program—will help keep Albertans informed of potential hazards and ready to respond.



Oil-field development can also impact directly on soil and water quality. Land spreading of oil-field wastes, such as drilling fluids, can either harm or help soils, depending on the type of soil and the materials used in the drilling mud.

In Saskatchewan, for example, scientists at the federal government's Swift Current Research Station have demonstrated that mixing small quantities of sludge into highly erodible and almost sterile marginal soils makes that land highly resistant to erosion, improves soil respiration and aids in increasing the numbers of microscopic organisms available to improve the soil's ability to support growth.

Here in Alberta, the energy industry has done considerable work to find materials that will both aid in drilling and be beneficial—or at least neutral—when spread on the land. When drilling materials are found to be toxic, they now are treated to nullify the harmful effects. Alternatively, drilling fluids can be injected through disposal wells into deep-lying formations where they are contained and thus will not present a contamination hazard to soils or groundwater.

A Role for All

Protecting, nurturing and enhancing Alberta's environment is, of course, a shared responsibility. Governments at all levels, organizations such as the ERCB, corporations, environmental groups, children and adults, all have a role to play. For its part, the ERCB intends to continue working vigorously in this area. Some of its initiatives are discussed throughout this year's **Energy Alberta**.

Environmental Issues

The growing global concern over the production of waste in our industrial society, particularly those wastes termed "hazardous", has received special attention in Alberta. That concern led Alberta to establish the first major hazardous waste disposal facility in Canada, near the town of Swan Hills. The materials which must be processed at the Swan Hills plant are defined in the Hazardous Chemicals Act and Regulations.

Oil-field Wastes Are Difficult

Because of their specialized nature, most oil-field wastes are presently exempt from disposal at Swan Hills. Regulations to ensure their proper handling are the responsibility of the ERCB and Alberta Environment. Growing concern by government and industry over appropriate ways in which to handle the large volumes of oil-field wastes led to a November 1989 Canadian Petroleum Association Waste Management Workshop.

As an outcome of this 2-day workshop, a series of committees have been struck to review such issues as deep well disposal, road application of oily wastes, waste processing and disposal facilities, incineration, and disposal of filters and process sludges. The meeting also reviewed and commented upon new waste disposal guidelines which had been developed from existing 1984 guidelines. The new guidelines should be finalized in 1990.

Drilling wastes are a particularly thorny issue. Since 1987, the ERCB has been a member of a multi-agency committee reviewing guidelines for the surface disposal of drilling wastes. The main steering committee is comprised of industry and government representatives, as well as representation from the service industry and major research groups.

The committee has recently endorsed a research study, gathering analytical data on drilling materials disposed in Alberta. Once completed, the study data will be correlated with chemical criteria from previous studies to determine the levels at which environmental protection can be maintained.

Meanwhile, until these guidelines are in place, the ERCB will continue to use existing policies to work with industry to ensure oil-field wastes are handled carefully and appropriately.

Groundwater Concerns Increase

Another major concern for Albertans is the long-term maintenance of high-quality groundwater supplies. Frequently, the ERCB encounters concerns about the perceived depletion of or damage to groundwater resources by the energy industry. These concerns include possible water contamination from seepage of gas or oil from resource wells drilled to deeper zones in search of hydrocarbons.

While Alberta Environment's Water Resources Management Services is the administrator of groundwater licensing for the province, the ERCB maintains close liaison with it in order to minimize the impacts of the energy industry. The ERCB's computerized well data system allows instant access to information on well casing, completion, production and injection for every oil, gas and oil sands production well in the province, as well as on all injection or deep disposal wells licensed by the Board.

Prairie Conservation: A New Alberta Concept

One of Alberta's most recent and exciting environmental initiatives is the broadly-based movement to preserve representative segments of the remaining natural prairie in Alberta, as well as some of the parkland zones which lie between prairie and forest lands.

At present, one of the largest segments of natural prairie remaining in Western Canada is the Suffield Military Range north of Medicine Hat. It is not, however, the undisturbed prairie that some suggest. Aerial photographs show traces of early pioneer settlement. Military activities are routinely carried out on a portion of the 2500-square-kilometre land surface and 137 heavy oil wells, 3497 gas wells and 1864 kilometres of pipelines have been developed on the site by the energy industry. The wells operate from underground steel silos and are adequately protected so as not to interfere with military manoeuvers. A small portion of the reserve is off limits to all activity and is a major wildlife preserve. Environmental protection for the land is achieved through the Suffield Environmental Advisory Committee—on which the ERCB serves—which advises the base commander on gas and oil developments. The committee also counsels Alberta Energy Company Ltd., the only company working in the area, on how best to integrate with military operations and mitigate environmental impacts.

Alberta's remnant prairie grasslands and parklands became the focus of preservation efforts in 1989.

Smaller, but perhaps more representative, are the remnant prairie grasslands near Altario and in the Rumsey Block, the largest remaining segment of aspen parkland in the world. Both areas are Crown land.

The Rumsey Block has long been recognized as a unique transitional parkland. Some 13 sections in the north of the 70-section block are designated for an ecological reserve. Although there are oil and gas wells in the proposed ecological reserve, the Alberta government is no longer approving new mineral leases. Should an ecological reserve ultimately be declared, the existing wells would be allowed to operate to completion and then carefully abandoned and the well sites reclaimed to very strict standards.

The main issue raised by interveners at a hearing in 1989 near Altario was the disturbance to native prairie grasslands that would be caused by the proposed well and access road.

Interveners expressed concern about the resistance of native prairie grasses to drought conditions, and the difficulty of reclaiming that type of biological community once it has been disturbed.

A 5-year strategy for implementing native prairie conservation, through co-operative management and education, was discussed in the Prairie Conservation Action Plan (PCAP). The purpose of PCAP is to influence government and industry policy and attitudes, so as to conserve the biological diversity remaining in the Canadian prairies.

In late 1989, the ERCB was invited to participate in the PCAP Implementation Committee. This committee provides a forum for information exchange and for exploration of various approaches to prairie conservation activities which the Board strongly endorses.

This is the largest multi-party committee of its kind ever established in the province, and the ERCB welcomes this excellent opportunity to contribute to the work of preserving endangered habitat.

In 1989, the ERCB also initiated discussions with the Special Areas Board of Municipal Affairs, and with Alberta Forestry, Lands and Wildlife to draft recommended practices for oil and gas activity on native prairie grasslands. The first version of these recommendations should be available for industry and public review in early 1990.

Alberta's Energy Resources

Much of this section of **Energy Alberta** examines the crucial role of reserves in the development, production and marketing of Alberta's energy resources.

Determining reserves for Alberta's wide variety of energy resources–that is, how much we have left to recover–can be complex work. Also, the terminology used can often be confusing. There are *established reserves* (those we know are there because someone drilled into them), *remaining reserves* (what's left after subtracting how much has been produced in a given year) and *ultimate potential* (a "best guess" at what eventually will be recovered).

Reserves are at the heart of the energy industry. The province's reserves of oil, natural gas, coal and oil sands mean Alberta is Canada's major source of fossil fuels; 78 per cent of the nation's reserves of conventional oils, 91 per cent of its natural gas, virtually all of its oil sands and 53 per cent of its coal. After three generations of production, only Alberta's remaining reserves of conventional crude oil are dwindling. For other fossil fuels, annual established reserve additions generally continue to outstrip production.

3. Alberta's Energy Resources (in petajoules)

Remaining reserves at the end of 1989

Conventional Oil and Equivalent	22 350
Natural Gas and Equivalent	63 700
Bitumen and Synthetic Crude Oil	153 000
Coal	578 000

1989 Marketable Production

Conventional Oil and Equivalent	2 350
Natural Gas and Equivalent	3 250
Bitumen and Synthetic Crude Oil	745
Coal	665
Hydro	6

1989 Sales

	To Alberta	To Other Provinces	Exports	**Total**
Crude Oil and Equivalent	740	1 215	1 140	3 095
Gas	710	1 170	1 370	3 250
Coal	460	45	160	665
Hydro	6	0	0	6
Total	**1 916**	**2 430**	**2 670**	**7 016**
Per cent of Sales	27	35	38	100

Conventional Crude Oil

Alberta's conventional crude oil production in 1989 was an estimated 54.8 million cubic metres, slightly lower than 1988, and less than predicted. Two main factors appear to account for the drop. First, established pools did not produce as well as anticipated. Additionally, a year of poor financial performance within industry influenced drilling activity, failing to replace depleting reserves.

Slow Year for Drilling

The decreased level of drilling activity in 1989 matched the depressed years of 1983 and 1986. Drilling for light and medium oil was off more sharply than drilling for heavy crude oils. Only 1251 successful oil wells were drilled in 1989, a 45 per cent decrease from the previous year.

A number of factors contributed to this decline. Market and price uncertainties led to a number of company mergers and acquisitions. In light of uncertain world oil prices, operators seemed more willing to purchase known productive oil properties than take the risk of exploratory drilling.

Drilling Incentives and Royalty Tax Credits End

Following the slump in world oil prices in 1986, the Alberta government introduced a number of incentive programs to assist the industry in adjusting to lower prices. Most of these programs ended in 1989. For example, the Crude Oil Royalty Holiday Program (CORH), which came into effect in 1986, had provided for 5-year, 3-year and 1-year royalty holidays for new exploration activity, but it was discontinued in 1989.

However, the Alberta government announced the implementation of a long-term, price-sensitive Alberta Royalty Tax Credit Program. This program will rebate a percentage of royalties payable to enhance industry cash flow, particularly to smaller producers. The rebate will vary depending on oil prices, and will have a 5-year life-span to encourage long-range planning. Another incentive that was phased out in April 1989 was the federal government's Canadian Exploration and Development Incentives Program.

Horizontal Wells on Increase

Horizontal oil wells have emerged as a topic of growing interest during 1989. Eighteen such wells were drilled, double the previous year. Almost half these 1989 wells were drilled on a commercial basis, rather than being approved as experimental.

A horizontal well completion exposes more wellbore area at the producing formation than does a vertical well. This permits more oil to enter the wellbore with less pressure loss. Several special applications for horizontal wells present themselves. For example, with reduced pressure loss, a horizontal well in an oil zone with water below it should tend to provide more oil production with less water as compared to a vertical well. Also, near the edge of a pool an operator might not be able to justify another vertical well, but drilling horizontally could significantly increase chances of recovering additional oil or gas.

Another application might involve a tight formation, where the viability of a vertical well is marginal but a horizontal well might prove to be economic. A horizontal well might also be the best way of exploring for a small but potentially significant, tough-to-find geological "sweet spot."

The Board is "cautiously optimistic" that horizontal wells have the potential to increase recovery, particularly in marginal reservoirs. Such wells can also be drilled with less surface disturbance, thus reducing environmental impacts and potential conflicts with other users.

Horizontal wells may pose some interesting future challenges in terms of needed regulations to govern such matters as well spacing and drainage patterns. During 1989, ERCB staff assessed the regulatory challenges of horizontal wells on an individual basis. While most existing guidelines were found to apply to horizontal wells, these rules were put in place when vertical drilling was the order of the day. Thus, current regulations may not cover all of the potentially difficult situations.

Although horizontal drilling may look the same as conventional drilling at the surface, it offers the potential to increase oil recovery while reducing environmental impacts and land-use conflicts.

Focus on Waterfloods, Pressure Maintenance Schemes

During 1989, the ERCB dealt with 46 applications for new enhanced oil recovery schemes and 150 applications for amendments to existing pressure maintenance projects.

Enhanced oil recovery is any method which involves adding energy to the reservoir to supplement its natural pressures, thereby increasing total hydrocarbon recovery. These schemes can involve injecting water or gas into an oil reservoir, or the use of solvents such as ethane, propane or carbon dioxide to flush the oil from small pore spaces in the rock.

The majority of new schemes in 1989 dealt with pressure maintenance by waterflooding. As for the more complex miscible floods, while the ERCB approved many applications for enhancements to existing schemes, 1989 marked the first time in many years that no new miscible floods were approved. One reason may be that most of the best reservoir candidates for miscible flooding already have been implemented.

Oil Sands

Two interrelated activities characterized oil sands and heavy oil activity during 1989: technological and environmental problem-solving.

Advances in science now hold the promise of more efficient and environmentally sound oil sands developments. Dealing effectively with the enormous scale of oil sands projects is an ongoing challenge for all.

Team Approach to Issues

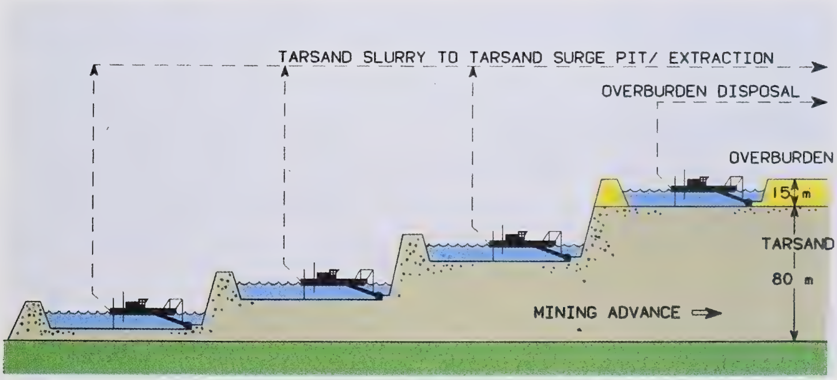
Preparatory work on the proposed $4 billion OSLO project during 1989 was a case in point. Although OSLO does not plan to file a formal application with the ERCB until the fall of 1990, the ERCB initiated the Application Review Team (ART) approach to processing and evaluating the OSLO oil sands project.

Made up of representatives from ERCB, OSLO, provincial and federal governments, Native groups and local municipalities, the OSLO ART team will address such matters as basic resource information, both surface and subsurface, technological aspects related to efficient resource recovery and plant operation, the environmental impact assessment process, emission concerns, fish and wildlife impacts and an analysis of jobs, business opportunities and infrastructure requirements in nearby communities.

This approach was first used in 1986 for Syncrude's mine and plant expansion, and again in 1988 for the Suncor Debottlenecking Project.

As with the OSLO ART process, the review of Suncor's debottlenecking project will consider all aspects of the proposal including resource conservation, regional and local environmental controls (an important matter for this pioneer oil sands plant built in the mid-60s) and socio-economic impacts. One element of this total project was Suncor's Naphtha Recovery Unit. During 1989, this unit began recovering hydrocarbon liquids and scavenging volatile gases escaping from the tailings which have been a major source of odour complaints in the area.

Mining Schematic
OSLO Conceptual Oil Sands Dredging
(vertical scale exaggerated)



Odour Complaints Investigated

Hydrocarbon odours continue to be a major concern in Fort McMurray and Fort McKay. Both Suncor and Syncrude have ongoing programs to investigate odour sources and mitigate off-site impacts. The ERCB is actively involved with Alberta Environment in these investigations, which are aimed at correlating each complaint to specific plant operations and eliminating its cause.

Under the auspices of a Regional Air Quality Coordinating Committee established in 1988, an enhanced odour investigation procedure also has been brought forward. The hiring of a manager and two additional staff is expected to significantly improve odour tracking in 1990.

Technological Developments Continue

To advance the development of oil sands in the future, it is very important that mining and extraction costs be lowered and environmental impacts reduced significantly. To this end, OSLO continued to assess its program of experimental dredging and cold water recovery of bitumen at a site north of Fort McMurray. A larger-scale field demonstration is planned for 1990.

Oil sands operators and the ERCB also recognize the urgency of developing an extraction process which significantly reduces the tailings and sludge which are by-products of the current hot water extraction processes used. Such changes would reduce water requirements, lowering the costs of impounding the tailings and thus lowering the costs of their ultimate reclamation. Also, the large area typically covered by tailings ponds may sterilize substantial oil sands reserves located below the ponds for many years.

The ERCB approved an OSLO pilot project in northeast Calgary to test a modified hot water extraction method that aims at clarifying tailings, thus reducing sludge accumulation and ultimately yielding a substance that does not require large structures to impound tailings. OSLO is also using this test facility to develop the engineering design specifications for the particular oil sands ore it will be using in its commercial plant.

Construction moves forward on a coal-fired furnace to raise steam for extracting ***in situ*** *oil sands.*

In Situ Developments

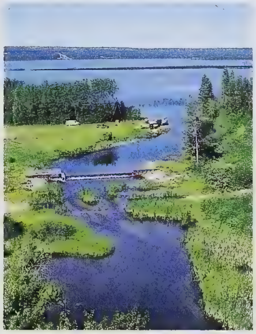
The relatively new technology of horizontal drilling showed continued success at several of Alberta's in situ oil sands operations. During 1989, the Board approved four new applications for experimental horizontal drilling in the Wabasca and Cold Lake areas. Although such wells are more expensive initially than vertical steam injection wells, they hold the promise of increased recovery from oil sands reservoirs.

Esso Resources also received approval in 1989 to test a new coal combustion technology at its Cold Lake in situ operations. Although Esso originally had applied to use coal to generate steam for its development at Cold Lake, it subsequently applied to use natural gas when the project was downsized. The Board approved the use of gas, with a proviso that Esso continue its investigations into the use of coal. With prospects for increasing markets and higher prices for natural gas, plus improvements in coal-burning technologies, the timing now seems right for such a test facility.

A joint venture (TransAlta Utilities is a partner, along with Esso and Shell), with federal, provincial and industry funding, the $7.5 million pilot project will be the first full-scale test of an efficient coal-burning furnace designed to raise the large volumes of steam required.

This pilot project is of substantial interest to many. On the one hand, if the test is successful it may improve the economics of in situ oil sands facilities. (The cost of using natural gas to raise steam accounts for 35-40 per cent of the total bitumen supply price.) On the other hand, environmental issues associated with coal mining and transportation, as well as the possibility of increased emissions, will need to be addressed.

New water recycling guidelines for oil sands and heavy oil extraction projects should lessen demand on freshwater sources such as Cold Lake.



Water use by in situ oil sands and heavy oil projects also is an ongoing concern, especially in the Cold Lake area. In response to local concerns that water availability is being affected by oil sands projects, the ERCB and Alberta Environment jointly released *Guidelines for Water Use in In Situ Oil Sands Facilities in Alberta* in May 1989. These guidelines stipulate that projects will be approved only if they properly address water reuse and include the implementation of water recycling as an integral part of any proposed scheme. The goal of the new guidelines is to reduce fresh water requirements and waste water disposal volumes.

The Cold Lake Air Quality Task Force, with input from ERCB, Alberta Environment and the public, published the results of a local emission survey during 1989. Results indicated that on a regional basis, in situ oil sands operations have minimal impacts on air quality. However, the survey did recommend an annual review of regional air quality and suggested the relocation of static monitoring stations. These recommendations now are being implemented.

Oil Sands Drilling Fluctuates

During the past few years oil sands drilling has seen wide fluctuations based on the timing of large schemes, notably Esso Cold Lake and BP Wolf Lake. Full development of these and other schemes has been held back because of uncertainty in oil prices and markets.

Nineteen eighty-nine witnessed reduced drilling within large, developed oil sands schemes. Drilling in the mineable areas continued, primarily by OSLO to evaluate the extent of reserves and the thickness of pay zones within its lease.

Although 1989 can be characterized as a very slow year for oil sands drilling, it is expected to increase in the coming years. Several oil sands leases will expire in the next few years unless companies qualify to renew them. With the potential for schemes in the mineable areas, the opportunities for increased drilling in the future appear promising.

Natural Gas

In 1989, Alberta's energy industry shifted farther away from its traditional focus on oil, and geared up to meet the challenges of an increasing gas market. Despite an overall drop in drilling activity in 1989, exploration for natural gas matched the high levels set in 1988.

Natural gas wells made up half the total number of successful wells drilled in 1989, an increase of about 28 per cent over the previous year. A look back at the past 5 years shows that the ratio of exploratory to development wells was fairly constant, with 26 to 34 per cent of all wells being exploratory. However, 1989 statistics revealed an increase to 48 per cent for exploratory wells, a reflection of the sustained search for natural gas.

The ERCB issued 219 gas removal permits in 1989. Despite continuing price stagnation, the volumes of gas removed from the province equalled the previous record level set in 1988 at 61 billion cubic metres.

The review of the province's gas removal policy is ongoing. Key issues to be resolved are the degree of protection for Alberta's domestic needs in the future and the administrative system to make it market sensitive.

In a 1989 report entitled *Energy Requirements in Alberta*, the ERCB predicted a sharp increase in gas prices by the turn of the century. Most of that increase will result from a growing demand among U.S. customers for Canadian natural gas. As much as 60 billion cubic metres of natural gas per year could be delivered to the U.S. without affecting the supply destined for Canadian use.

Pipeline capacity will play an important function in this scenario. The year 1989 witnessed the continued growth of the NOVA gas transmission system within Alberta, along with plans to expand the capacity of major pipelines leaving the province.

Increased activity in the gas processing field also seemed to point to an industry poised to increase capacity during the '90s. The ERCB received 48 applications for new or expanded gas plant facilities in 1989, a 33 per cent increase over the previous year.

Competing Gas Processing Proposals for Caroline

A great deal of development and public consultation work has been done in the Caroline area since the discovery of a large gas field in 1986. During 1989, the ERCB received competing applications from Shell Canada Limited and Husky Oil Ltd. to construct facilities to process the gas from this field. Extensive consultation by the industry and strong involvement by local communities have been significant features in the planning of each of these proposed developments. The ERCB participated actively in the process in order to explain its own role in the review and evaluation of applications, and to inform the public about how they could participate in related public hearings scheduled for April 1990.

Wheat and natural gas–both produced from the resource storehouse known as Alberta.

Gas Plant Proliferation Policy

During 1989, the ERCB initiated an industry awareness program to encourage optimum use of gas processing plants. A draft informational letter was sent to industry for comment in late 1989, with a final policy document being expected by mid-1990.

The development of new gas plants often prompts environmental concerns from the public and questions about rising custom processing fees from industry. Conflicts have become evident in recent years because gas plant developments increasingly are encroaching on other rural and urban activity. The Board is drawn into these land-use conflicts because it has to adjudicate these issues.

In a related initiative, Alberta's Minister of Energy wrote to the petroleum producer associations in August 1989 to say that he is "concerned that excessive gas processing charges cause hardship for some producers, encourage proliferation of gas plants, hamper conservation of solution gas, and undermine freehold and Crown royalties." He added that he prefers industry to address the situation and develop a solution which would avoid regulatory intervention on the part of the ERCB and the Public Utilities Board. A reply to the Minister from the industry associations was made in early 1990.

The Board expects that these initiatives will reduce the need for new facilities and promote greater use of existing gas processing plants.

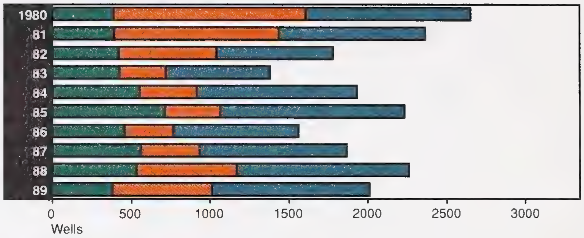
Alberta's Energy - An Historical Perspective

The following charts provide a 10-year perspective on Alberta's conventional oil, bitumen and synthetic crude oil, as well as natural gas and sulphur activities.

4. Oil and Gas Wells
Exploration

1989 witnessed an increase in exploratory gas wells and a decline in the search for oil, the result of how industry viewed market opportunities.

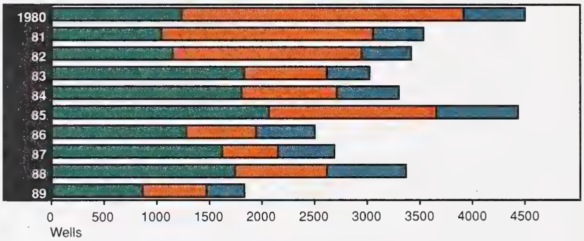
🟦 Abandoned and Other



5. Oil and Gas Wells
Development

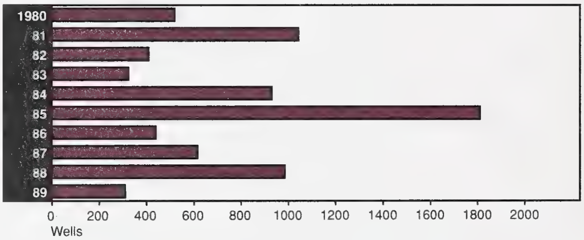
Development drilling decreased by 45% from 1988 to 1989, the lowest level of activity since the early 1970s.

🟦 Abandoned and Other



6. Oil Sands Wells

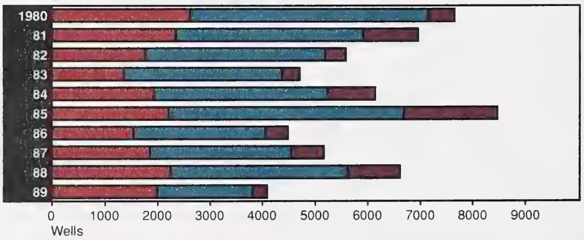
Oil sands drilling plummeted in 1989. The proposed OSLO scheme was largely responsible for the drilling that did occur.



7. Total Wells Drilled

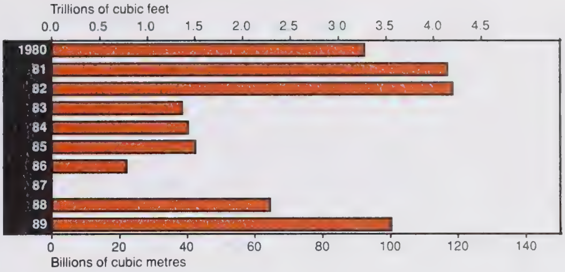
Total wells drilled in 1989 was even less than previous lows in 1986 and 1983.

🟥 Exploration
🟦 Development
🟪 Oil Sands



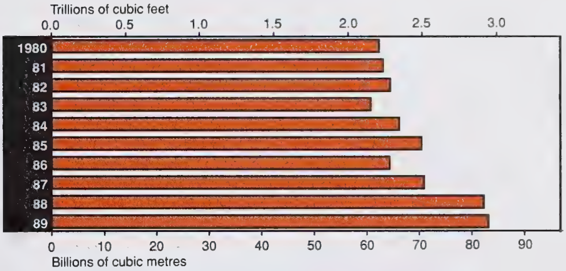
8. Additions to Established Gas Reserves

With 1989 exploratory drilling for natural gas up slightly over 1988, an additional 100 billion cubic metres of reserves were proven during the year.



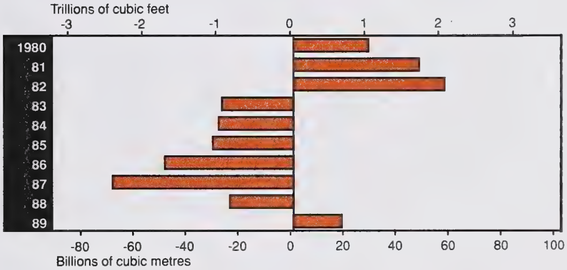
9. Gas Production

1989 levels of gas production equalled the record level set in 1988.



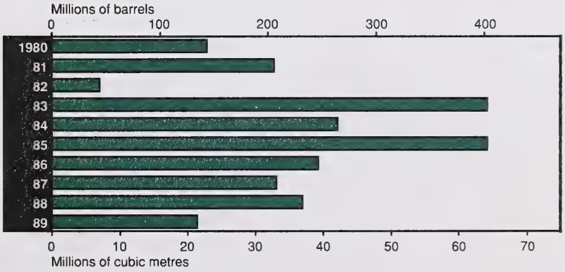
10. Changes in Remaining Established Gas Reserves

1989 reversed a 6-year trend of producing gas faster than it was being discovered.



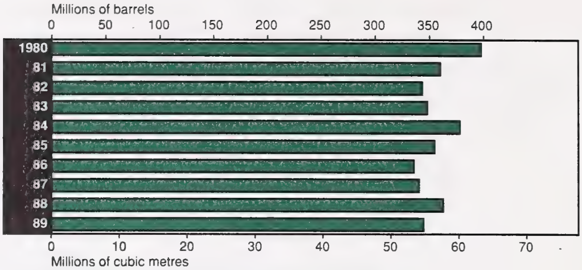
11. Additions to Established Oil Reserves

The year's drop in drilling activity for oil produced a marked decline in new reserves.



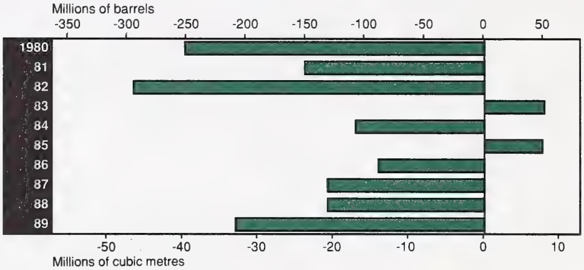
12. Conventional Oil Production

Sluggish drilling activity and the general depletion of established pools explain the declining trend of conventional oil production.



13. Changes in Remaining Established Oil Reserves

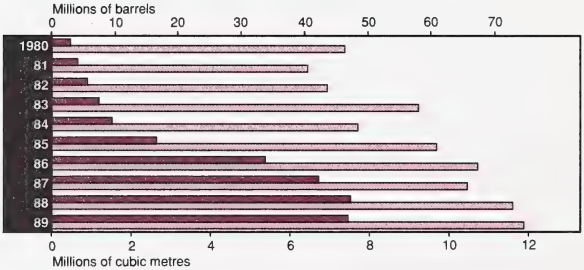
An overall decline in recoverable reserves of conventional crude oil continued throughout the 1980s as production outstripped reserve additions.



14. Bitumen and Synthetic Crude Oil Production

Production of energy from oil sands was above record production levels in 1988.

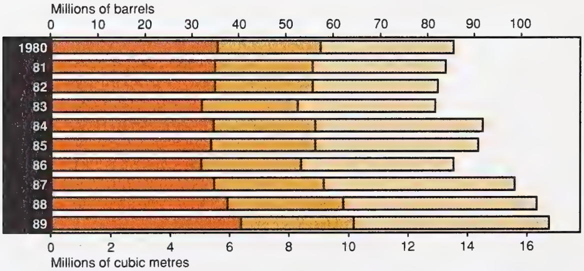
■ Bitumen
□ Synthetic Crude Oil

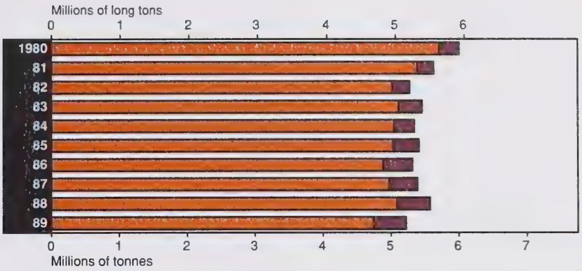


15. Natural Gas Liquids Production

The production of NGLs, primarily used as a petrochemical feedstock, was up slightly in 1989.

■ Propane
▨ Butanes
□ Ethane





16. Sulphur Production

Alberta's sour gas processing plants produced slightly less sulphur in 1989 than in 1988. Reduced export sales resulted in additions to stockpiles.

🟧 Gas Plants
🟥 Oil Sands Plants

Coal

Coal Production Up for Third Year

Alberta's 1989 production of raw[1] coal increased by 5 per cent over 1988 levels, to an estimated 35.0 million tonnes compared to 33.4 million. Deliveries of marketable[2] coal also increased 5 per cent to 30.8 million tonnes. Alberta's current recoverable reserves, by surface and underground methods, now are estimated to be 32 gigatonnes.

The coal demands of both domestic and export markets are expected to remain strong through the 1990s. Deliveries of bituminous metallurgical and thermal coals increased by 2 per cent and 8 per cent respectively over 1988—a record for coal exports. Use of subbituminous coal by electric power plants was up 5 per cent because of increases in the export of electricity and in domestic consumption.

Although international coal prices increased, the increased value of the Canadian dollar largely offset the gains received by coal producers for offshore export sales. Continued improvement in both coal prices and coal demand will allow existing mines to operate at designed capacity, increasing production in the province an additional 3 to 4 million tonnes annually. There are no plans to open new mines at this time, but Alberta has several already approved mines (McLeod, Mercoal, Bow City) still awaiting market development. These mines may open if coal prices increase significantly, or if long-term coal contracts become available.

The Obed Mountain Coal Mine near Hinton has been sold to Luscar Ltd. by Unocal Canada Limited and Norcen Energy Resources Limited. This mine produced 1.6 million tonnes of clean coal in 1989 and has a designed capacity of 3 million tonnes per year. The Smoky River Coal Mine near Grande Cache increased its production by about 20 per cent over 1988. It was also granted an extension by the ERCB to include development of its No. 11 Mine, thus ensuring sufficient coal reserves to maintain present production levels of about 2 million tonnes of clean coal per year.

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[1] Unprocessed coal as loaded in the mine, also known as run-of-mine coal.

[2] Subbituminous raw coal and bituminous raw and clean coal (processed product with a uniformly low ash content) delivered to market.

Coal exploration also continued to increase over the past year. During 1989, a total of 589 exploration holes were drilled, compared to 344 holes in 1988. Particularly interesting is the exploration undertaken by Chinook Coals Ltd. in the Coleman area to delineate reserves for a possible surface mine.

A review of regulatory procedures for major coal development projects was completed in 1989 by the ERCB, Alberta Energy, Alberta Environment and Alberta Forestry, Lands and Wildlife. As recommended, a Coal Coordinating Committee was formed to implement the recommendations and to continue the regulatory review process.

The Board also notes a number of coal research projects initiated over the past year which are aimed at reducing the environmental effects and increasing the utilization of Alberta's coal resources. These projects are funded jointly by the provincial and federal governments and by the industry. Notable is the development of a low-emission, coal-fired boiler for steam injection in heavy oil recovery. There are also studies of a fine-coal cleaning and upgrading process to enhance the energy content and combustion performance characteristics of coal.

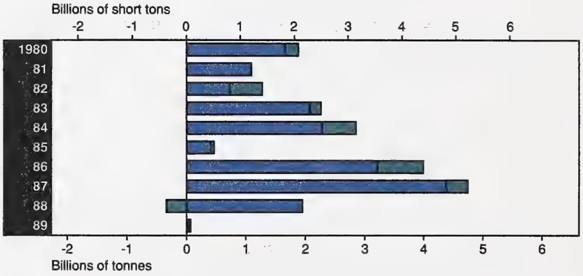
Because transportation costs remain a major obstacle in marketing Alberta's coal to extra-provincial markets, another project of interest is the development of a coal/oil slurry pipeline system to transport pulverized coal, mixed with oil, through existing pipelines.

The industry is also focusing on how to improve the recovery efficiency in underground operations. A thick-seam mining project at one of the underground mines of Smoky River Coal Limited is designed to demonstrate the technical feasibility of an integrated mining system to extract coal seams in excess of 3.66 metres (12 feet) thick in a single pass.

17. Additions to Initial Established Coal Reserves

1989 witnessed only minor additions to coal reserves.

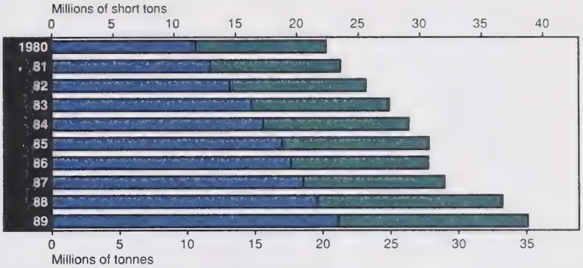
🟦 Subbituminous
🟩 Bituminous



18. Coal Mine Production (Raw Coal)

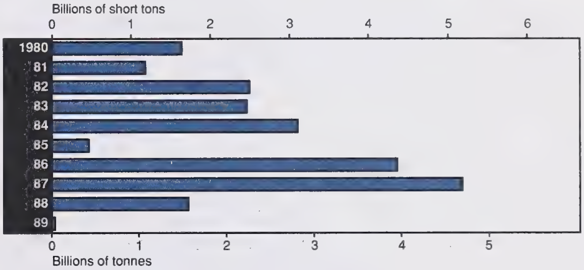
1989 production rose by 5 per cent with increases in both subbituminous and bituminous coals.

🟦 Subbituminous
🟩 Bituminous



19. Changes to Remaining Established Coal Reserves

Alberta's 1989 remaining reserves of coal were unchanged at 32 gigatonnes.



Electricity

Alberta's electrical industry experienced an active year in 1989, not so much in terms of new development, but certainly in terms of working out regulatory processes and resolving controversial issues.

On the development side, small power producers continued to propose novel approaches for generating electricity, in response to the government's small power policy. In addition, the potential health effects of electric and magnetic fields became an issue at a hearing to consider the routing of a 240-kV line through communities in Southeast Edmonton and Sherwood Park.

Small Power Producers Forge Ahead

Since the provincial government first introduced its Small Power Program in 1988, the ERCB has received 20 applications for small-scale electrical generating facilities.

Near Whitecourt, for example, one small producer proposed the use of wood waste from local pulp mills as a fuel source in a local power scheme. Interest in generating hydroelectricity at the 7-year-old Dickson Dam on the Red Deer River near Innisfail (originally constructed to control water levels on the river) produced four competing applications. The outcome of an ERCB hearing into these applications was issued in January 1990. In the fall of 1989, the ERCB also received an application to construct a 3-megawatt steam turbine power plant at Trochu, to be fuelled by burning used automobile and truck tires.

In Pincher Creek, the Alberta government announced a $3 million program aimed at developing renewable energy sources such as wind and solar power. The ERCB expects that applications will soon be filed for projects proposed under this new program. Several small power proposals were also received from local entrepreneurs and Irrigation Districts to produce power from irrigation schemes. Five such projects have already been approved for development, all in the southern part of Alberta. The Board also approved two applications for wind turbine generators in southern Alberta during the year.

Closing the Loop

During 1989, Alberta Power completed construction of a direct current converter station linking Alberta's interconnected system to that of Saskatchewan Power near the border village of Empress. Saskatchewan Power will use the connection to provide reserve capacity for its system.

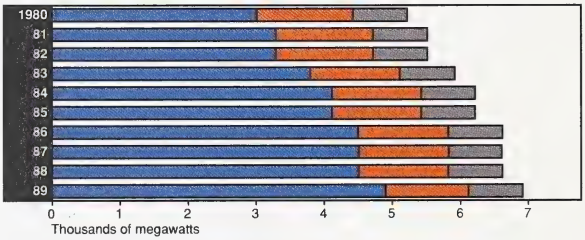
Genesee Comes on Stream

After lengthy delays, 1989 saw the start-up of the first of two generating units at Edmonton Power's Genesee Power Plant. Completion of the Genesee project has been hampered by changing growth in the electric demand for the province.

20. Electric Generating Capacity

The start-up of a unit at the Genesee Power Plant in 1989 was largely responsible for the 4.5% addition to Alberta's generating capacity.

▨ Hydro



Transmission Line Approved for Sherwood Park

In May 1989, the ERCB gave TransAlta Utilities permission to construct and operate a double-circuit 240-kV transmission line in the Ellerslie-East Edmonton area after a lengthy public hearing. In its application, TransAlta had proposed two routing alternatives—a westerly route between two existing high-voltage lines, and an easterly route within the Restricted Development Area (RDA) set aside for utilities and pipelines. The panel heard twenty-three submissions from interveners concerned about the two routes, including those who objected to the route through a residential area in East Edmonton. Another residents' group objected to an alignment adjacent to a school and through several communities within the Sherwood Park West RDA.

The Board also considered the concerns expressed by many interveners about the potential health effects from electric and magnetic fields (EMF) associated with high-voltage transmission lines. With the help of expert witnesses on the EMF issue, the Board concluded that biomedical research and epidemiological studies conducted elsewhere in North America have not demonstrated harmful biological effects from such transmission lines; thus, the question of health effects should not influence its decision on placement of the line. The Board approved the construction along the western route proposed by the applicant.

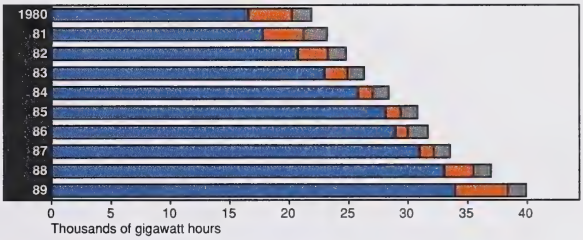
Planning Parameters

During 1989, the industry requested the ERCB to conduct a review of planning parameters used to determine the need for new power plants. The review focused on the capability of existing facilities, the reliability criteria to be used in planning new plants and the extent to which Alberta should rely on its extra-provincial interconnections to provide reserve capacity. These parameters are an important issue for planners in the electrical industry. The Board's report on this matter will be available in 1990.

21. Electricity Generated

Alberta's electric generating facilities produced 8% more power in 1989 than 1988.

▨ Hydro



Pipelines

NOVA Expansion Under Review

NOVA Corporation, which operates the provincial transmission and gas-gathering network, invested $400 million in expansion during 1989. NOVA is expected to make similar investments in new facilities in the coming years to accommodate the growing opportunities for new gas sales in Canada and the United States.

Since 1980, the ERCB has reviewed and approved many NOVA pipeline applications in accordance with guidelines set out in its *Informational Letter IL 80-10*. Several factors prompted the ERCB to initiate a review of these guidelines in 1989. In a general way, Alberta's natural gas industry has experienced major structural changes since the advent of deregulation in the mid-80s. Also, the short-term and long-term impacts of NOVA's significant expenditures for its proposed expansion on transportation costs, wellhead revenues and the competitiveness of Alberta gas in the marketplace, needed review.

During 1989, ERCB staff met several times with representatives from industry associations, NOVA, the Alberta Petroleum Marketing Commission, and gas utilities, as well as some shippers, seeking their input to the review. This important work will continue in 1990.

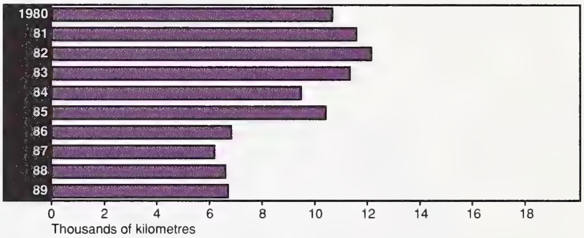
Routing Sour Gas Lines Is Challenging

The approval in mid-1989 of the Phillips Petroleum Resources Ltd. pipeline from the Salter Gas Field to Petro-Canada's Wildcat Hills Gas Plant west of Calgary highlighted the fact that routing sour gas pipelines is becoming an increasingly complex issue. The public hearing demonstrated that safety, land values and environmental concerns are vitally important to the public when a company proposes to route such a pipeline through relatively populated areas. Although only 33 kilometres in length, this pipeline passes through settled areas north of the Morley Indian Reserve, then crosses the Ghost River and Highway 1A before reaching the Wildcat Hills plant west of Cochrane.

Across Alberta, more than 100 landowner concerns about pipelines were resolved in 1989 without public hearings. The ERCB now has one person dedicated mainly to pipeline mediation. In addition, the Pipeline Department co-ordinates the work of its inspectors in the field, analysing matters such as safety, technical issues and environmental and landowner concerns on a province-wide basis.

22. Pipelines Installed

The added capacity and economic value of new pipeline development in 1989 was up significantly over 1988.



Ongoing Review of Pipeline Standards

As part of its regulatory approval process, the ERCB now requires all pipelines in Alberta to meet or exceed the pipeline standards set by the Canadian Standards Association. On a worldwide comparison, Alberta's safety record for pipelines is one of the best.

In the past decade, epoxy and polyethylene internal coatings have greatly improved the reliability of pipelines, especially where salt water and sour gas are being produced.

The methods for installing pipeline also have been modified over time. For example, topsoil conservation is now a vital element in pipeline construction. While the very nature of pipelining implies an impact on the "good earth", measured in earth time most agricultural land disturbed by pipelines is fully productive after 2 years. Even visible forestry rights of way will be regrown within 50 years of abandonment.

Sales and Distribution

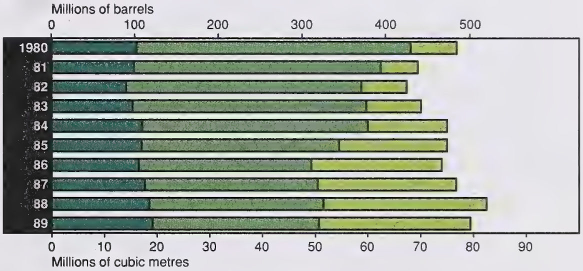
Sales of Alberta's energy resources showed a substantial decline in volumes of sulphur and a modest reduction in conventional crude oil. Other resources such as natural gas, coal and electricity experienced slight sales increases during the year.

Deliveries of Alberta's crude oil (and equivalent resources such as bitumen and synthetic crude oil) averaged 220 000 cubic metres per day in 1989, down from 230 000 in 1988. This decrease included a sharper-than-expected drop in the production of conventional light oil. Pipeline capacity, a problem hampering deliveries of Alberta oil as recently as 2 years ago, was no longer a concern for oil producers during 1989.

Nineteen eighty-nine saw a marginal increase in the amount of conventional crude oil delivered within Alberta and a decrease in the amount of oil going to British Columbia. This change was due to Alberta refineries sending partially refined products to British Columbia for further processing rather than pipelining unrefined crude oil. Quebec refineries, which require substantial quantities of light crude oil, took less oil from Alberta because of slightly cheaper offshore supplies.

23. Markets for Oil and Equivalent

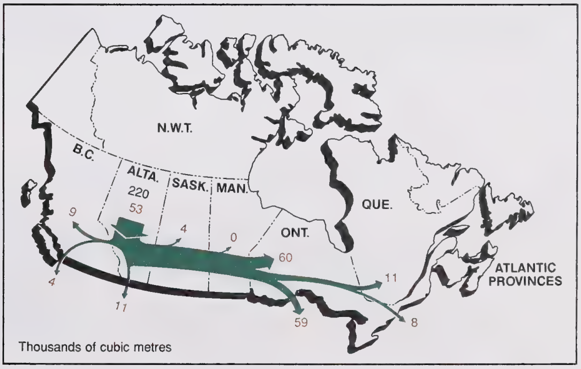
Except for modest growth in the Alberta consumption of oil, deliveries of oil decreased to traditional markets because total production declined.



🟩 Alberta
🟩 Other Canada
🟩 U.S.A.

24. Markets for Oil and Equivalent in 1989

Legend
Production
Deliveries



Pipeline capacity, both inside and outside Alberta, proved to be an important limiting factor in delivering Alberta's natural gas to markets. After a substantial 1988 increase in Alberta's natural gas exports to the United States, 1989 sales remained steady. Expansion of NOVA's gas transmission system within the province, as well as pipeline additions outside Alberta to feed other provinces and U.S. markets, now are necessary before additional volumes of gas can be delivered.

The links between Alberta and its continental markets often mean that far-off events influence energy resource production at home. For example, when a cold snap enveloped the American northeastern states at the end of 1989, propane prices in Alberta rose. Regional shortages of propane in the United States caused the price to quadruple. Alberta producers then rushed to meet demand and as a result Alberta consumers also found themselves paying more for propane.

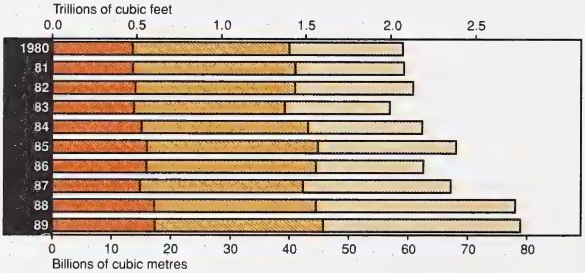
Changes in world markets can also affect Alberta. For example, deliveries of Alberta's sulphur to offshore markets witnessed a dramatic decline during 1989 in the wake of the collapse of a contractual agreement between Morocco and India. (Morocco is an importer of Alberta's sulphur.) For the first time in many years, sulphur production in Alberta exceeded exports, forcing producers to stockpile until market conditions improved towards the end of 1989.

Export markets also are an important consideration for Alberta's coal industry. In 1989, deliveries of coal to Pacific Rim countries constituted almost one-quarter of Alberta's total marketable coal. The quantity of coal to generate thermal power in Alberta increased slightly in 1989.

25. Markets for Gas

U.S. markets consumed about the same amount of Alberta gas in 1989 as 1988. Deliveries to other provinces increased slightly.

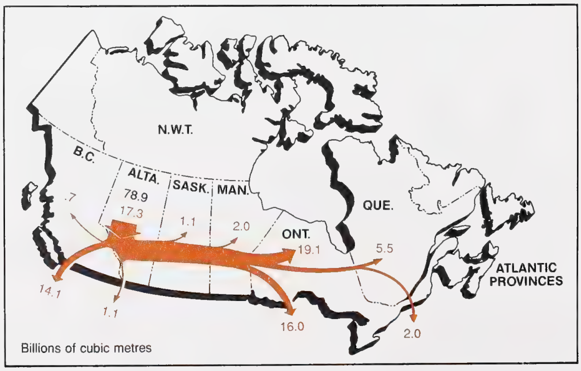
🟧 Alberta
🟨 Other Canada
⬜ U.S.A.



26. Markets for Gas in 1989

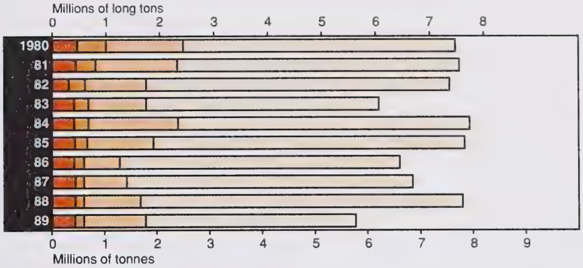
Ontario continues to be Alberta's best Canadian customer for natural gas.

Legend
Production
Deliveries



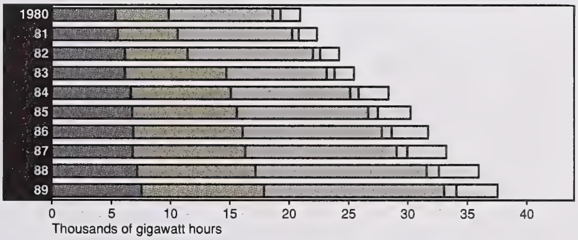
27. Markets for Sulphur

Morocco is a major importer of Alberta's sulphur. When its fertilizer contract with India collapsed, Alberta's overseas shipments fell sharply.



Sulphur from Alberta moves to west coast ports for shipment to markets around the world.

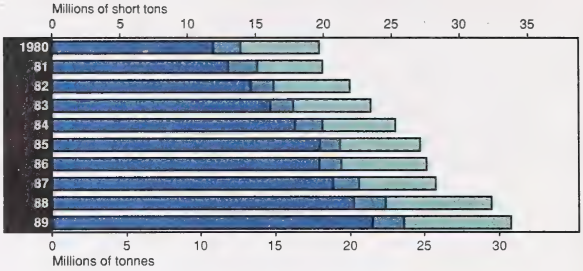
28. Electric Energy Markets



29. Markets for Coal

Alberta's electric energy industry, Ontario (Hydro) and Japan continued to be the main markets for Alberta coal in 1989.

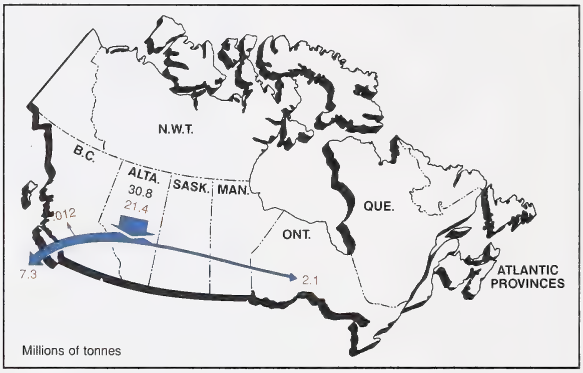
- ■ Alberta
- ■ Other Canada
- ▨ Offshore

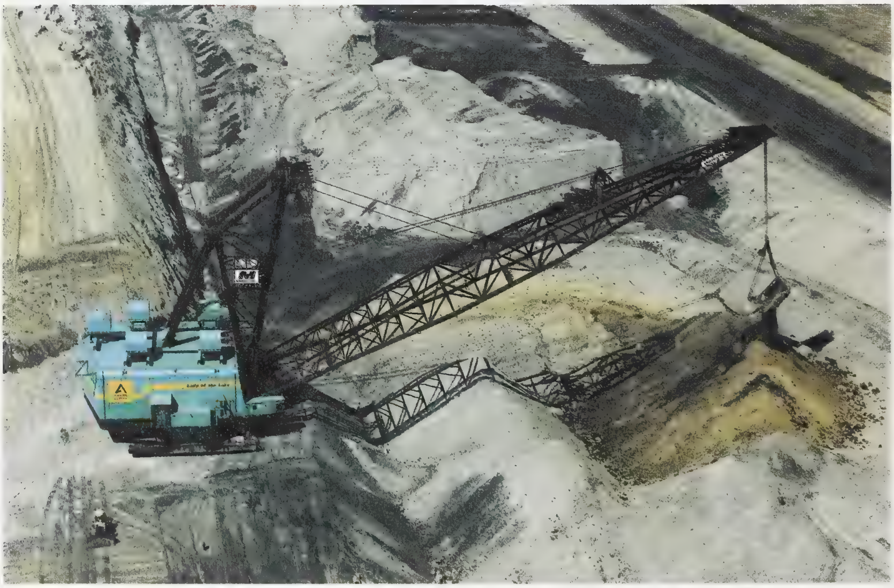


30. Markets for Coal in 1989

Japan, Korea and Brazil continued to be the major offshore markets for Alberta coal in 1989.

Legend
Production
Deliveries





Alberta's Highvale Mine west of Edmonton produces more coal than any other mine in Canada.

Revenues, Investment, Employment

Sales Revenues

The total sales value of Alberta's energy resources and sulphur was an estimated $16.5 billion in 1989, about 9 per cent higher than 1988. This was the result of better world oil prices, 1989 compared to 1988. Despite growing optimism in Alberta's natural gas industry and slight increases in marketable gas sales, revenues decreased marginally to $4.5 billion because of stagnant gas prices and the increased value of the Canadian dollar vis-a-vis American currency. This reduced the net back price–the price after transmission costs are subtracted–paid to Alberta gas producers. The average value of natural gas liquids, especially for butanes, was significantly lower in 1989 compared to the previous year. Propane prices experienced a sharp weather-related increase at the end of 1989.

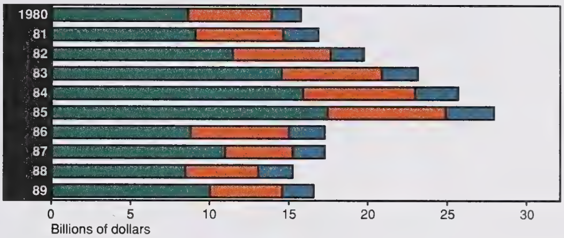
Despite a considerable decline in sulphur sales to overseas markets, 1989 sulphur prices, on average, remained the same as in 1988. The price for sulphur was marginally higher at the beginning of 1989 and then dropped sharply in September. Sulphur revenues for the year totalled $400 million, down from $577 million in 1988.

Revenues for coal were up marginally to $430 million. While international coal prices rose, the increased value of the Canadian dollar largely offset the gains received by coal producers for offshore export sales.

31. Gross Revenues
All Hydrocarbons

The total sales value of Alberta's energy resources and sulphur was an estimated $16.5 billion in 1989, about 9 per cent higher than 1988, the result of better world oil prices.

▨ Other



Investment

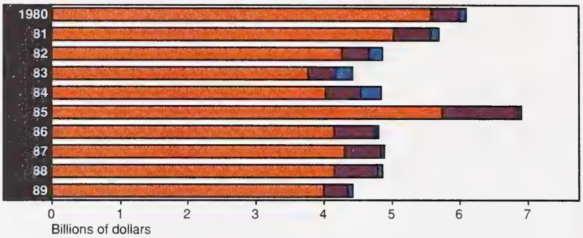
The energy industry's capacity to invest is, with some delay, affected significantly by swings in energy commodity prices on a global scale. Total energy investment in Alberta is estimated to have decreased to $4.4 billion. This decline in investment, especially in drilling and exploration activity, was a legacy of the low world oil price at the end of 1988, at a time when companies were finalizing 1989 exploration and development budgets.

Unlike the relatively low level of investment in oil-related activity in Alberta, investment in the natural gas industry was encouraged by the prospect of significant growth in U.S. demand for Alberta gas. Total investment funds raised by and for Alberta's energy industry improved substantially in 1989, with external financing quadrupling during the year compared to 1988. However, much of this investment was used for acquisitions, not for actual development activity.

32. Energy Investment in Alberta

Investment in Alberta's energy industry was down slightly in 1989.

🟧 Gas and Conventional Oil
🟪 Oil Sands
🟦 Coal

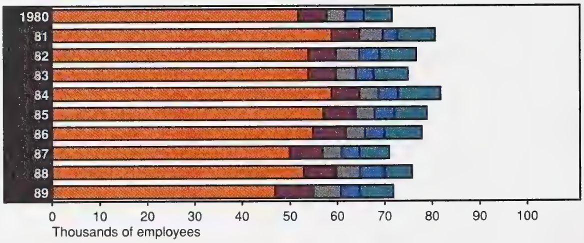


Employment

Alberta's energy industries employed an estimated 72 000 people in 1989, 6 per cent of the total Alberta work force, down slightly from 1988. This figure does not include the thousands of spin-off jobs—such as those in the service and construction industries—that rely directly on the health of the energy sector. Most of the decrease in employment came in the oil and gas sector, but with slightly fewer jobs in the coal and petrochemical industries as well. Some growth occurred in oil sands operations and in the electrical generating field.

33. Employment in Alberta's Energy Industry

🟧 Oil and Gas
🟪 Oil Sands
⬜ Electricity
🟦 Coal
🟩 Petrochemicals



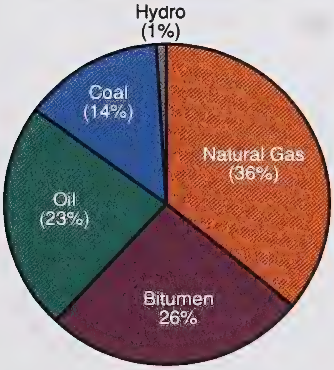
Alberta Energy in Perspective

Alberta's fossil fuel resources and their by-products find their way into people's lives in Alberta, across North America and around the world. During 1989, Alberta continued to be the major source of energy for Canada and a significant exporter to American and offshore markets.

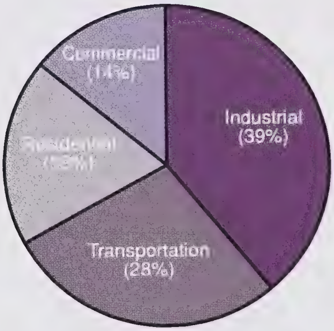
Almost all of Alberta's energy requirements is supplied from the province's own hydrocarbon reserves. Figure 34 shows the energy resources used to meet Alberta's domestic requirements in 1989. For example, Alberta coal was the source of 14 per cent of all the energy used in the province during the year, generating the lion's share of the electricity consumed by Albertans.

The relative "draw" of each end-user sector on the province's total energy consumption is shown in Figure 35. The industrial sector remains the largest single consumer of energy in Alberta and, as shown in Figure 36, this sector is expected to grow at the fastest rate in the future.

34. Energy Resources to Meet Alberta's End-use Requirements—1989



35. 1989 End-use Requirements in Alberta

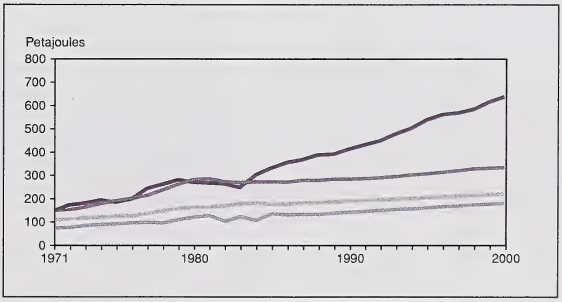


Industrial activity also affects the other end-use sectors. A case in point is the energy required for pipelining oil and gas, which appears as a factor in the transportation portion of energy end-use.

Consumption of fossil fuels as secondary energy in Alberta (see Figure 36) was essentially unchanged from 1988 to 1989. The industrial sector leads in terms of consumption of electricity.

36. Secondary Energy Requirements by Sector

The industrial sector is expected to provide an increasing share of the secondary energy market in the future.



Growth in the remaining three sectors of the provincial economy is largely driven by increases in population. Partly because of the stable growth of Alberta's population since the early 1980s, residential, commercial and transportation energy use are experiencing slower rates of growth than the industrial sector. Continued improvements in the efficiency of energy use by consumers also appears to be influencing this more gradual increase in energy demand.

Alberta in the Canadian Energy Picture

The major portion of Canada's known reserves of oil, natural gas, bitumen and coal is located in Alberta. Table 37 shows the national distribution of Canada's known energy resources.

Future Production

Alberta's conventional light oil production is likely to outstrip new discoveries and provincial supply is expected to decline to less than half of current levels by the end of the century. This decline could be offset by additional production from new or expanded synthetic crude oil and crude bitumen projects. However, the long lead-times required to build such facilities and the somewhat uncertain supply of capital raise serious questions about how quickly this will occur. In the longer term, it is anticipated that projected price increases should allow synthetic crude oil and bitumen production to double by early in the next century. The prospects for natural gas production appear positive in the '90s.

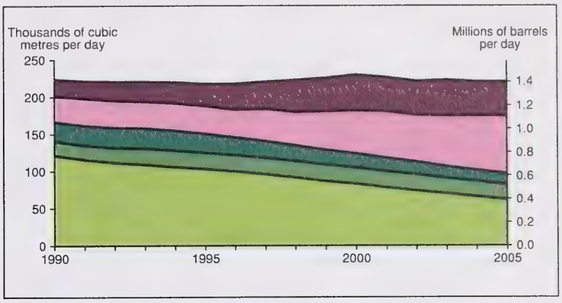
37. **Alberta vs Canadian Reserves and Production** (in petajoules)

Remaining reserves at the end of 1989	Alberta	All of Canada	Percentage Reserves in Alberta
Conventional Oil and Equivalent	22 350	28 800	78
Natural Gas and Equivalent	63 700	70 000	91
Bitumen and Synthetic Crude Oil	153 000	153 000	100
Coal	578 000	1 084 700	53
Total	**817 050**	**1 336 500**	**61**

1989 Marketable Production (estimated)	Alberta	All of Canada	Percentage Production in Alberta
Conventional Oil and Equivalent	2 350	3 000	78
Natural Gas and Equivalent	3 250	3 900	83
Bitumen and Synthetic Crude Oil	745	745	100
Coal	665	1 680	40
Hydro	6	1 030	1
Nuclear	0	280	0
Total Production	**7 016**	**10 635**	**66**

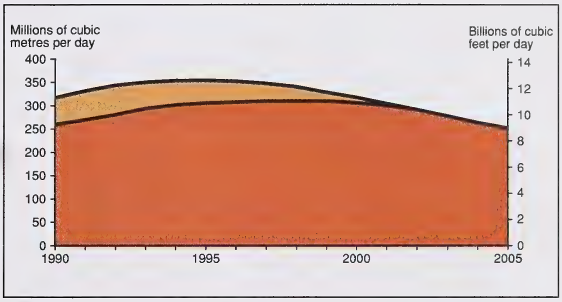
38. Oil and Equivalent Supply 1990-2005

🟪 Bitumen
🟪 Synthetic Crude Oil
🟩 Heavy Oil
🟩 Pentanes Plus
🟩 Light and Medium Oil



39. Gas Capacity and Production 1990-2005

🟧 Capacity
🟥 Production



Pipelines carry energy resources to markets efficiently. Most agricultural land disturbed by pipeline construction is fully productive after 2 years.

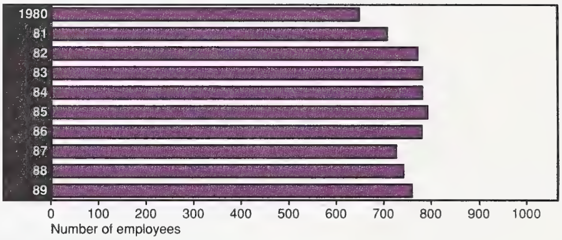
ERCB Operations

ERCB internal operations during the closing year of the 1980s were directly influenced by trends affecting Alberta's energy industry. Corporate mergers and increased activity by new and smaller companies meant increased administrative and regulatory work for ERCB staff. This was combined with the ongoing review processes associated with major projects such as the production surveillance project, the Caroline gas processing applications, the OSLO oil sands project and the NOVA pipeline expansion.

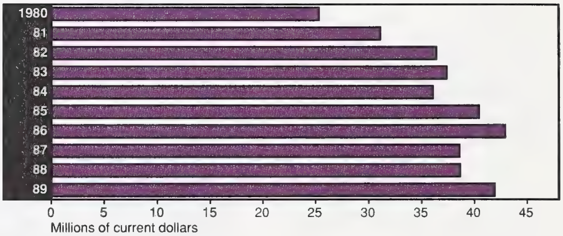
Despite this workload the ERCB experienced only a moderate increase in expenditures and staff during 1989. Total expenditures in 1989 were $41.8 million compared to $38.5 million in 1988. This included costs resulting from a major new assignment involving the Alberta government's objective of verifying the accuracy of oil production measurement and improving the accounting of the Crown's share of energy revenues.

The ERCB's employee count increased from 739 in 1988 to 755 in 1989, largely because of the need for additional production surveillance staff.

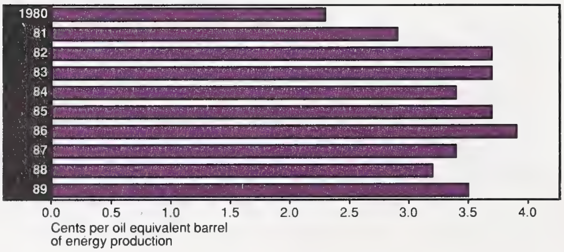
40. ERCB Staff



41. ERCB Expenditures



42. ERCB Expenditure Index



Meter Checks

Most of Alberta's oil is produced through batteries–a central gathering location for production from several outlying wells. Total production at such a battery is measured on a continuous basis. However, production attributable to individual wells feeding the battery is calculated using measurement data gained from regular tests at each well. Such tests allow production at the battery to be prorated to each well, based on individual well performance. Most of these batteries rely on live-oil meters to measure this test production. Calibrating such equipment is usually contracted out to meter provers who specialize in this work. In recent years, the ERCB has developed a program of in-service calibrations of test oil meters. These tests have been conducted at random by ERCB staff. This program was considered necessary after performance testing of existing meter proving companies indicated significant inaccuracies. This meter calibration and verification is part of an increased emphasis on the accuracy of production measurement, a program initiated in conjunction with the provincial government.

The ERCB formally initiated this performance-monitoring program in September 1989 after an extensive period of design, calibration and verification of its own equipment and procedures.

By year-end, the ERCB had conducted 15 meter calibration checks, of which 2 proved to be unsatisfactory by ERCB standards. In these 2 cases, the ERCB required the meters to be recalibrated to meet acceptable limits. In both cases, this work entailed changes or modifications to the prover's equipment or procedures. Field surveillance of oil production facilities will intensify in 1990.

Industry Mergers and the ERCB

While the most visible impact from corporate mergers was the significant reduction in drilling activity by the major players in Alberta's energy industry, the ERCB's application review process and enforcement work also faced challenges. The emphasis on "smaller players, smaller plays" meant ERCB staff had to invest more time familiarizing company personnel about ERCB regulations during 1989. The ERCB Geology Department's experiences proved to be typical.

Small companies tend to be synonymous with limited staff and operating budgets. ERCB geologists noted an increase in requests for waiver of logging and sample requirements. In many cases, this was the result of the number of companies not utilizing well-site geologists.

These factors, plus a lack of familiarity with ERCB regulations, prompted numerous queries for information. In terms of hearings and well licenses, penetrating a small pool may mean a request to drill outside normal target areas. This often leads to landowner concerns, especially in agricultural areas. In addition, drilling outside target areas may cause equity concerns between operators. During the year, ERCB staff found themselves involved in many such meetings with independent operators to resolve these kinds of issues.

Corporate mergers in 1989 also resulted in a flood of routine administrative work for ERCB staff. As the province's main repository of energy data, the ERCB worked to keep pace with the steady increase in transfers of items such as well licences and pipeline permits.

Improved Mapping Capabilities

As part of its efforts to enhance access to energy information, in June 1989 the ERCB installed the first of a four-phase computer mapping system destined to change the way the ERCB produces maps. The goal of the project is to provide ERCB staff, government and the public with more comprehensive, accurate and standardized energy-related maps.

Throughout the past decade the ERCB has developed one of the world's largest energy databases. The new mapping system significantly enhances access to any combination of more than 1200 elements of mappable information on the ERCB database. Whether it be estimating reserves, processing applications for new energy projects, or identifying geological formations accurately, the new software will mean the integration of all in-house mapping systems into a powerful graphics tool.

Production Information System Modernized

The ERCB also implemented a new system for collecting and disseminating all basic production data in the province during 1989. The Production, Injection Disposition system (PID) is part of a larger program to improve and verify the accuracy, reliability and integrity of production measurement and reporting, particularly as it relates to the provincial government's share of resource royalties.

In addition, the new system standardizes production reporting formats in the three western Canadian provinces. Companies now use standard forms to report all production information regardless of provincial boundaries although each jurisdiction maintains its own records.

The ERCB's Production Accounting Department conducted nine seminars during 1989 to introduce industry staff to the new reporting system. While companies experienced some difficulty in adjusting to the system's new requirements, the resulting structure enhances the ability to capture accurate production information for all interested parties.

Orphan Wells

During the year, the Board also found it necessary to recommend a modified process whereby the industry and government may control the public risk from inactive wells.

The Board earlier identified an emerging trend where marginal oil and gas producing properties are purchased by smaller operators who then may be unable or unwilling to handle well abandonment, site restoration and clean-up problems when a well finally becomes uneconomic to produce. Changes recommended by the Board would ensure responsibility for proper abandonment is maintained by the primary beneficiaries.

Orphan wells are those wells for which the licensee of record is insolvent and other responsible parties cannot be traced. If the well has been properly abandoned, becoming an "orphan" is not likely to cause a problem. However, in instances where difficulties are encountered with an orphan well, the job of solving those problems falls to the ERCB. The safety of such wells is an important public consideration, and can represent a significant financial liability.

Concern over the problem of such orphan wells led the ERCB to tighten restrictions in 1989 on the transfer of well licences from one company to another. The ERCB's Legal Department also worked on the legal obligations, responsibilities and status of the operators who assume responsibility for such wells.

As part of the orphan well issue, the ERCB also completed a review of inactive well shut-in and maintenance operations. Proposed improvements in such practices are intended to ensure that inactive wells are properly suspended to reduce the risk of uncontrolled hydrocarbon flow to the surface or to underground formations. New procedures for suspended well requirements will be implemented in 1990.

Alberta Recommended Practices for Critical Wells

An important milestone in terms of field operations was the April 1989 release of *Alberta Recommended Practices* (ARPs) to enhance the safe completion and servicing of critical wells in Alberta. The term "critical" identifies those sour gas wells where the prevention of blowouts is paramount because of the potential for serious consequences should one occur. These new ARPs reflect the commitment of industry and the ERCB to reduce the likelihood of a blowout and to improve public and worker safety near critical sour wells.

The ARP document is distributed by the Petroleum Industry Training Service under the auspices of the Blowout Prevention/Well Servicing Committee (BPWSC). The formation of BPWSC was a major industry/government initiative, including more than 150 individuals serving on 15 subcommittees.

The ARPs place the responsibility on the operator to follow good practices at all times, rather than requiring mandated changes to ERCB regulations. Only 23 recommendations—out of the hundreds of items discussed in the ARPs—involved regulatory changes by the ERCB. Industry has agreed that the ARPs are reasonable and flexible and can be consistently applied throughout the province. The ERCB considers the ARPs an important step in that such practices place considerable onus on the legally responsible party (the operator) to either comply, or otherwise provide a technically-equivalent or better solution.

These detailed completion and servicing ARPs follow an earlier set of practices that were issued in 1987 for the drilling of critical wells.

Improving Rig Quality

Alberta's rig quality has improved substantially in the last 5 years.

The ERCB's Field Operations Department reported continued province-wide improvement in rig quality. "Unsatisfactory" inspections of 44 per cent in 1985 have now been reduced to 6 per cent.

The ERCB believes that part of the reason for improved rig performance has been improved communication with operators as well as contractors. For its part, the ERCB, with input from industry, issued two "best seller" manuals, the *Rig Inspection Manual* in 1986 and the *Service Rig Inspection Manual* in 1988. Both publications explain what ERCB regulations mean in practical situations.

Reporting Casing Failures

The ERCB's Drilling and Production Department issued a reminder to all operators in 1989 concerning the new regulation requiring reporting of all casing failures. (Casing is the steel pipe in a well, used to prevent the wall of the hole from caving in, and through which oil or gas is produced.) The ERCB is now building a casing failure and corrosion database for wells throughout Alberta.

Since the new regulation came into effect, the ERCB has received more reports of casing failure than anticipated. Many of these can be attributed to older drilling practices which contributed to external corrosion of the casing string.

Hearings and Interventions

The year 1989 marked the 10th anniversary of the ERCB's local interveners' costs program. The system allows all reasonable costs incurred by local interveners for legal assistance, research or expert witnesses to be recovered and then paid by the company.

A review of this system during 1989 revealed that costs awards have remained reasonable. Since the program began, a total of $1.9 million has been awarded to 349 individuals, families or groups. Thus, the average intervener award is just over $5500.

The local interveners' costs program applies to those people defined as having a legal interest in land, and who may be directly or adversely affected by a decision of the Board regarding a proposed energy facility. The mere existence of local interveners' costs provisions is believed to have encouraged discussion between proponents and affected parties, resulting in private settlements of the costs of negotiation. The Board encourages such private agreements.

ERCB Management Team

Board Members

G. J. DeSorcy	Chairman
N. A. Strom	Vice Chairman
B. F. Bietz	
F. J. Mink	
E. J. Morin	
J. P. Prince	

Executive Manager–Operations

R. G. Evans

Managers

Accounting	R. T. Bording
Administrative Services	K. G. Sharp
Coal	R. G. Paterson
Communications	J. K. Bales
Data Processing	H. Antonio
Drilling and Production	J. R. Nichol
Economics	J. W. Newton
Employee Relations	R. F. Braun
Environment Protection	H. Lillo
Field Operations	W. G. Remmer
Gas	J. D. Dilay
Geology	C. A. Langlo
Hydro and Electric	T. F. Homeniuk
Legal	M. J. Bruni
Oil	N. G. Berndtsson
Oil Sands	R. N. Houlihan
Pipeline	E. G. Fox

New Board Member

The mid-August appointment of Dr. Brian Bietz as a member of the Board proved timely in view of the increasing focus on environmental issues. Dr. Bietz has built an excellent reputation in the environmental impact assessment field, and increases the available Board support on a broad range of matters typically faced by the ERCB.

Additional information on the ERCB and its activities can be obtained from:

1.	Information Services	403-297-8190
2.	ERCB Library	403-297-8242
3.	Communications Department	403-297-3596

All three information sources are located in the ERCB Head Office at
640 - 5 Avenue S.W., Calgary, Alberta, T2P 3G4.

Energy Resources
Conservation Board
640 Fifth Avenue SW
Calgary, Alta. T2P 3G4

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